

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : <b>B07B 1/46</b>	<b>A1</b>	(11) International Publication Number: <b>WO 00/43133</b>
		(43) International Publication Date: 27 July 2000 (27.07.00)

(21) International Application Number: PCT/GB00/00124

(22) International Filing Date: 20 January 2000 (20.01.00)

(30) Priority Data:  
9901208.0 21 January 1999 (21.01.99) GB  
9901979.6 29 January 1999 (29.01.99) GB

(71) Applicant (for all designated States except US): EXTEC INDUSTRIES PLC [GB/GB]; Extec House, 1 Grange Mill Lane, Wincobank, Sheffield S9 1HW (GB).

(72) Inventor; and

(75) Inventor/Applicant (for US only): DOUGLAS, Paul [GB/GB]; Extec House, 1 Grange Mill Lane, Wincobank, Sheffield S9 1HW (GB).

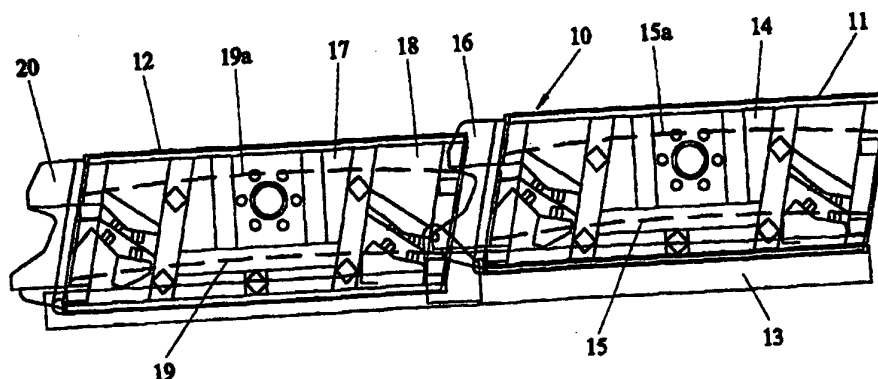
(74) Agent: ORR, William, Mclean; Urquhart-Dykes & Lord, Tower House, Merriam Way, Leeds LS2 8PA (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published

With international search report.

(54) Title: SCREENING DEVICE



(57) Abstract

A screening device for screening bulk material and having a screen deck (10) with a loading end (11) and a discharge end (12), and a frame (13) on which the screen deck (10) is mounted, in which the screen deck comprises: a primary screening section (14), and a secondary screening section (17) arranged downstream of the primary section (14), and adjustment means permitting adjustment of the screening angle of one of the sections relative to the other section.

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## SCREENING DEVICE

This invention relates to a screening device for separating-out material in a predetermined size range from a supply of bulk material to the screening device.

The material to be screened can take many forms, including site clearance material, and crushed stone, and the device has screening apertures which allow material smaller in size than the apertures to pass through while leaving residual material in the device (greater in size than the apertures) to be discharged separately. Depending upon requirements, desired material separated-out from the bulk material supply may comprise the material which has passed through the screening apertures, and / or may comprise the material of greater size than the screening apertures which is discharged separately.

In the screening of crushed stone, or site clearance material (including top soil), it is known to provide so-called "screen decks" which have a generally planar screening surface which is gently inclined to the horizontal so that bulk material can be loaded onto the deck at or near an upper loading end e.g. by discharge from an elevator or from a bucket loader, and then moved along the screening surface towards a lower discharge end while undergoing a screening action in which material smaller in size than the screening apertures is separated-out and is discharged downwardly through the deck to be received by a discharge arrangement e.g. a discharge chute or a discharge conveyor.

The screen deck may be coupled with a vibratory device which applies vibration energy to the deck in order to promote the screening action, and with the deck inclined to the horizontal, gravity action assists the movement of the bulk material over the screening surface. However, in some circumstances, the deck may be arranged substantially horizontally, so that forward movement of the bulk material

-2-

is derived mainly from the way in which the vibration energy is transmitted to the deck.

Evidently, the actual residence time on the screening deck of any particular part of bulk material being screened will depend upon (a) the nature of the material (b) the slope of the deck and (c) the vibratory energy transmitted to the deck. However, the desired residence time will be a compromise between achieving (1) an acceptable rate of throughput of bulk material and (2) screening efficiency. Thus, a more steeply inclined deck can achieve a faster throughput, but with disadvantage of lowered screening efficiency in that potentially screenable material may be carried over to be discharged with non-screenable material (material greater in size than the screening apertures).

It is therefore known to provide adjustable screen decks (and so-called screen boxes), so that the angle of inclination to the horizontal of the screening surface can be adjusted according to the nature of the material to be screened e.g. dry small aggregate can be handled efficiently with a steeper deck slope than is necessary for wet soil which will require a longer residence time.

After passing through the screening apertures, the screened material may be discharged to a stockpile via a discharge conveyor. Alternatively, the screened material may fall onto a further screening deck with different size screening apertures, if it is required to obtain a further screened size range of material.

The non-screened material which is discharged from a screen deck can be conveyed to any suitable discharge point, or if required can be routed to a further screening device.

Therefore, at present, a screen deck which provides a specific screening function can discharge one portion of screened material downwardly through the screening apertures under gravity action for further handling e.g. discharge to a stockpile or to treatment by a further separate screening

device at a different level; and can discharge a second portion of non-screened material from the discharge end of the deck for separate further handling e.g. discharge to a stockpile or treatment by a further and separate screening device also arranged at a different level.

Therefore, existing designs of screening plant usually have a number of screen decks arranged at different levels in order to screen material into different size ranges, and evidently the rate of output of the various screened size ranges of material will be dependent, inter alia, upon the screening area of each deck. If a large throughput of a particular size range is required, then a long deck will be provided, whereas for smaller rates of screening a shorter length of deck may be sufficient. Regardless of the length of the deck, at present entire decks are adjustable when it is desired to adjust the inclination of the deck for the purposes of varying the residence time of any particular material to be screened on the deck.

In the case of a long deck, this may have an adverse effect on screening efficiency since, with the entire screening surface of the deck inclined at the same angle, the speed of movement of the bulk material over the screening surface may vary lengthwise of the deck with consequent variation in effectiveness of the screening action. Thus, at the upper loading end of the deck, the layer of deposited material will be much thicker usually than the material as it moves along the deck towards the discharge end, with consequent variation in speed and screening efficiency. Therefore, with a long deck, the adjustment of the screening deck angle will necessarily have to be a compromise between a desired screening angle at the upper end of the deck (to give a particular desired residence time at the upper end) and the desired screening angle at other regions of the deck.

The invention seeks to provide a two section screen deck arrangement having improved adjustability of the deck angle compared with existing screen deck designs.

According to the invention there is provided a screening device for screening bulk material and having a screen deck with a loading end for receiving a supply of bulk material and an opposite discharge end for discharging the residue of the bulk material after passage over the screen deck, and a frame on which the screen deck is mounted; in which the screen deck comprises:

a primary screening section having a loading end to receive the supply of bulk material, and arranged to carry out a preliminary screening action and to discharge the residue of the non-screened material via an opposite discharge end;

a secondary screening section having a receiving end adjacent to the discharge end of the primary section and arranged to carry out a secondary screening action and to discharge residual non-screened material via an opposite discharge end; and,

adjustment means permitting adjustment of the screening angle of one of the sections relative to the other section.

Therefore, by the invention, there is provided a screening deck having at least two sections, and with independent adjustment of the screening angle of one section relative to the other, so as to permit optimum selection of screening angles for each section.

Preferably, the primary and secondary screening sections are mounted on a common sub-frame, which is itself adjustably mounted on a main frame. Therefore, adjustment of the sub-frame can set a general screening angle for the screen deck, and then separate adjustment of the screening angle of said one section can be carried out if required, so that, for any particular screening requirements, the primary

and secondary screening sections can have separate screening angles set to provide optimum screening efficiency.

If a longer screening deck is required, more than two sections (the primary and secondary sections) may be provided, and with independent adjustment of the screening angle of at least one of the sections relative to the other section(s).

In a preferred arrangement, the adjustment of the sub-frame will determine the screening angle of the secondary screening section, and the independent adjustment means will permit setting of a required screening angle of the primary section.

The screening device according to the invention may be incorporated in a static screening plant assembly. Alternatively, it may be incorporated in a mobile screening apparatus, preferably self-propelled.

Depending upon the required number of screened size ranges, there will be provision of further screening devices e.g. further screen decks, and preferably separate discharge conveyors will be provided in order to discharge, to separate stockpiles, screened material in different size ranges. The discharge conveyors are preferably foldable, so that they can take-up a suitable transport position, and can be deployed to outwardly extending discharge positions when in operation. The discharge conveyors may include tail conveyors and one or more side conveyors.

If a long multi-deck screen is required, then in a preferred development of the invention primary and secondary screen box sections are provided, which are otherwise similar to the primary and secondary screening sections referred to above.

A preferred embodiment of screening device according to the invention will now be described in detail, by way of example only, with reference to the accompanying drawing in which:

-6-

Figure 1 is a side view of a two section screen deck incorporated in a screening device according to the invention, and occupying one position of relative adjustment of the screening angle; and,

Figure 2 is a view, similar to Figure 1, showing a further position of relative adjustment of screening angles of the two sections.

Referring now to the drawing, this illustrates, in side view, a two section screen deck to be incorporated in a screening device according to the invention, and which is intended to separate-out material in one or more predetermined size ranges from a supply of bulk material to the screening device. However, if a longer screen deck is required, further section(s) may be provided.

The supply of bulk material to a screen deck can take place by any known means including elevators, and bucket loaders. Similarly, the discharge of one or more screened size ranges can take place via one or more discharge conveyors, and which are capable of being folded between transport positions and deployed outwardly extending positions, and can take the form of e.g. side conveyors and tail conveyors. All of these components are not shown in the drawings, but will be well known to those of ordinary skill in the art, and need not be described in more detail herein.

A screening device according to the invention may include further screening components to the two section screen deck which will now be described with reference to Figures 1 and 2 of the drawings.

The screen deck is therefore designated generally by reference 10, and has a loading end 11 for receiving a supply of bulk material, and an opposite discharge end 12 for discharging the residue of the bulk material after passage over the screening surface of the screen deck. The screening device has a main frame (not shown), and which may be part of a static screening installation, or may be incorporated into

the chassis of a mobile screening plant, preferably a self propelled plant. The screening device also includes a sub-frame, shown schematically by reference 13, on which the screen deck 10 is mounted.

The screen deck 10 comprises a primary screening section 14 which is provided with the loading end 11 which receives the supply of bulk material, and has a screening surface shown by dashed outline 15, on which a preliminary screening action is applied to the bulk material, and then the residue of non-screened material is discharged via opposite discharge end 16 of the primary screening section 14. The primary section 14 may comprise a single screen deck section 15, or may be a multi-deck or "screen box" type of arrangement, having a further screening surface 15a located above screening surface 15.

A secondary screening section 17 has a receiving end 18 arranged adjacent to the discharge end 16 of the primary section 14, and having a screening surface 19 (and preferably an overlying further screening surface 19a if a multi-deck section arrangement is required to provide a secondary screen box), and which carries out a secondary screening action on the residue received from the primary section 14, and then discharges the residual non-screened material via an opposite discharge end 20.

The primary screening section 14 and secondary screening section 17 are both mounted on sub-frame 13, and the sub-frame can be adjusted relative to the main frame in order to set a general screening angle for the screen deck formed by the assembly of primary and secondary screening sections 14 and 17. In the embodiment illustrated, this actually sets the screening angle for the secondary screening section 17, and adjustment means (not shown in detail) is provided to permit adjustment of the screening angle of the primary section 14 relative to the secondary section 17. Figure 1 shows a substantially co-planar adjustment of the

primary and secondary screening sections, whereas Figure 2 shows an upwardly inclined adjustment of the primary section 14, giving a steeper screening angle, and therefore a greater effect of gravity action of the bulk material while it undergoes screening action. The shallower screening angle of the secondary section 17, shown in Figure 2, will provide a longer residence time during which the residue of material received from the primary section 14 undergoes the secondary screening action.

It should be understood that the illustrated embodiment, showing independent adjustment of the screening angle of the primary section 14, is by way of example only, and that the invention contemplates independent adjustment of the secondary screening section 17, although this is not shown.

The invention also further contemplates the provision of independent adjustment of the screening angle of both of the sections 14 and 17.

Any suitable power or manually operated adjustment mechanisms may be provided in order to permit required adjustment of the screening angles of the screening sections of the screen deck.

As mentioned above, an effective single long screen deck can be provided by the two separate screening sections 14 and 17, but as shown the invention also contemplates the provision of an effective single long screen box assembly by provision of primary and secondary screen box sections, of which at least one is independently adjustable in its screening angle relative to the other.

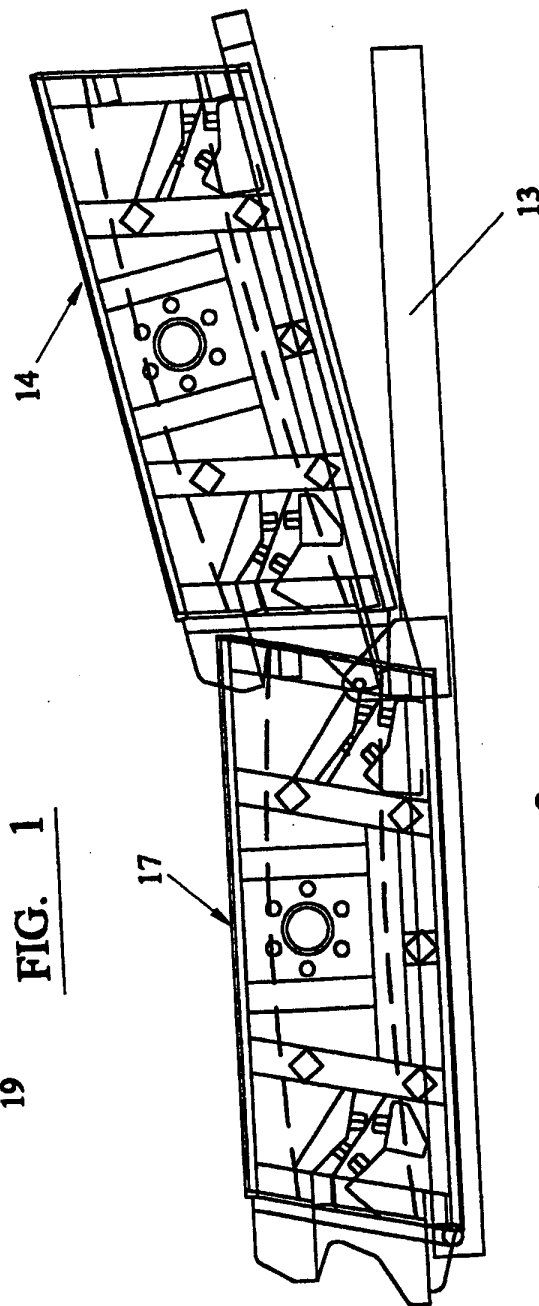
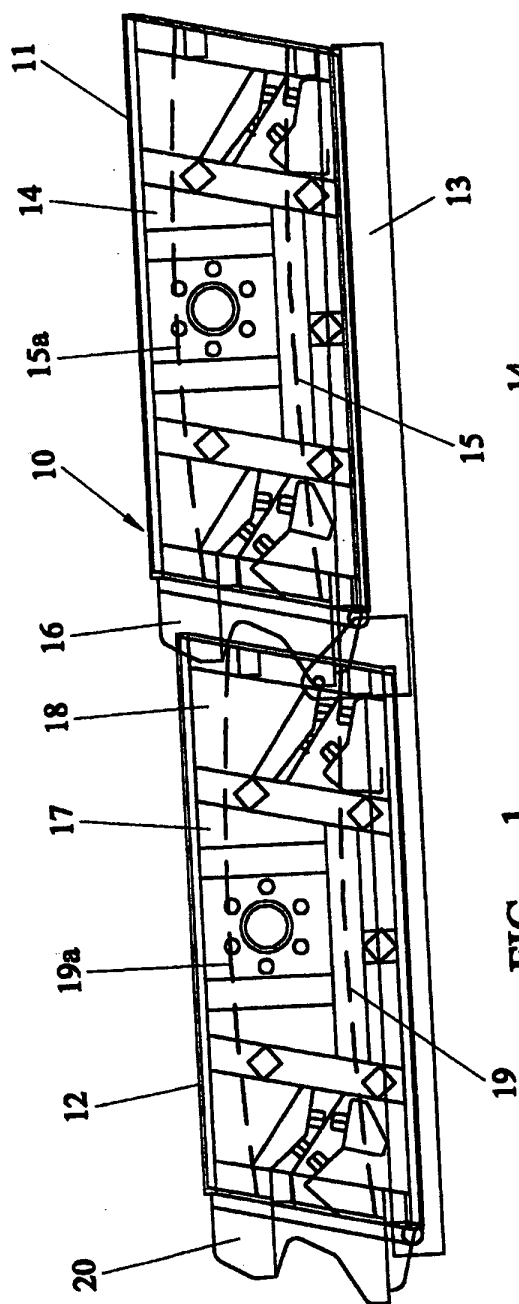
To promote the screening action, one, and preferably both of the sections 14, 17 incorporate vibratory devices 21 to apply vibrational energy to the screen decks.

## Claims:

1. A screening device for screening bulk material and having a screen deck (10) with a loading end (11) for receiving a supply of bulk material and an opposite discharge end (12) for discharging the residue of the bulk material after passage over the screen deck, and a frame (13) on which the screen deck (10) is mounted; in which the screen deck comprises:
  - a primary screening section (14) having a loading end (11) to receive the supply of bulk material, and arranged to carry out a preliminary screening action and to discharge the residue of the non-screened material via an opposite discharge end (16);
  - a secondary screening section (17) having a receiving end (18) adjacent to the discharge end (11) of the primary section (14) and arranged to carry out a secondary screening action and to discharge residual non-screened material via an opposite discharge end (20); and,
  - adjustment means permitting adjustment of the screening angle of one of the sections relative to the other section.
2. A screening device according to claim 1, in which the primary and secondary screening sections (14, 17) are mounted on a common sub-frame (13), which is itself adjustably mounted on a main frame whereby adjustment of the sub-frame (13) can set a general screening angle for the screen deck, and with separate adjustment of the screening angle of said one section being obtainable if required.
3. A screening device according to claim 1 or 2, in which a longer screening deck is provided, comprising more than two sections, and with independent adjustment of the screening angle of at least one of the sections being possible relative to the other section(s).

-10-

4. A screening device according to claim 2, in which the adjustment of the sub-frame (13) determines the screening angle of the secondary screening section (17), and independent adjustment means is provided to permit setting of a required screening angle of the primary section (14).
5. A screening device according to any one of claims 1 to 4, and incorporated in a static screening plant assembly.
6. A screening device according to any one of claims 1 to 4, and incorporated in a mobile screening apparatus.
7. A screening device according to claim 6, in which the mobile screening apparatus is self-propelled.
8. A screening plant assembly incorporating a plurality of screening devices according to anyone of claims 1 to 4, and including separate discharge conveyors arranged to discharge, to separate stockpiles, screened material in different size ranges.
9. A screening plant according to claim 8, in which the discharge conveyors are foldable, so that they can take up a suitable transport position, and can be deployed to outwardly extending discharge positions when in operation.
10. A screening plant including more than one screening device according to anyone of claims 1 to 4, in which each of the primary and secondary screening sections includes a multi-deck screen.



Int. l. Application No  
PCT/GB 00/00124

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 B07B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

[illegible]

Relevant to claim No.

**X**

DE 763 256 C (K. RATZINGER)  
28 December 1944 (1944-12-28)  
the whole document

**1,3,5,10**

**X**

US 2 058 959 A (P. DENNING)  
27 October 1936 (1936-10-27)  
page 1, right-hand column, line 15 -page  
2, right-hand column, line 22  
figures

**1,3,5,10**

**X**

GB 1 082 780 A (K. MULLER)  
13 September 1967 (1967-09-13)  
page 2, line 40 -page 3, line 10  
figures

**1.3.5**

-/-

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

\* Later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"a" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

06/04/2000

**30 March 2000**

Name and mailing address of the ISA  
European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax (+31-70) 340-3016

**Authorized officer**

**Laval, J**

# INTERNATIONAL SEARCH REPORT

In International Application No  
PCT/GB 00/00124

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 082 657 A (E. GAGE) 4 April 1978 (1978-04-04) column 1, line 46 -column 3, line 2 column 4, line 30 -column 5, line 20 figures	1,3,5
A	WO 97 41971 A (P. DOUGLAS) 13 November 1997 (1997-11-13) page 7, line 11 -page 10, line 33 figures 1-4	1,6-9
A	EP 0 316 461 A (INSTITUTE PO TCHERNA METALURGIA) 24 May 1989 (1989-05-24) the whole document	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/00124

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 763256	C	NONE	
US 2058959	A	27-10-1936	NONE
GB 1082780	A	NONE	
US 4082657	A	04-04-1978	NONE
WO 9741971	A	13-11-1997	DE 19781758 T 17-06-1999 DE 29723701 U 15-07-1999 GB 2331033 A 12-05-1999
EP 316461	A	24-05-1989	AT 65434 T 15-08-1991 IN 170781 A 23-05-1992 US 4855039 A 08-08-1989